CLAIMS

1. An apparatus for controlling an intake air amount in an internal combustion engine provided with a throttle valve and an intake air amount changing means linked with said throttle valve,

said intake air amount control apparatus for an internal combustion engine being provided with model equations creating a model of an engine intake system and expressing air passing through said engine intake system and

further having

a means finding a target intake air amount based on an accelerator opening degree and engine speed,

a means for determining a target setting for said intake air amount changing means based on at least said target intake air amount, and

a means for finding a target throttle opening degree, which is a throttle opening degree for realizing said target intake air amount, from said target intake air amount and said target setting based on said model equations.

2. An intake air amount control apparatus as set forth in claim 1, wherein said means for finding the target throttle opening degree has a means for finding a target intake pipe internal pressure, which is an intake pipe internal pressure at a downstream side of throttle valve for realizing said target intake air amount when said intake air amount changing means is set to said target setting, based on said target intake air amount and said target setting, and a means for finding said target throttle opening degree based on said target intake air amount and said target intake pipe internal pressure.

3. An intake air amount control apparatus as set forth in claim 1, wherein as said model equations, the apparatus has

a first equation expressing a relationship

between the intake pipe internal pressure on the downstream side of the throttle valve and a throttle valve passage air flow rate and determined in accordance with a throttle opening degree and

a second equation expressing a relationship between the intake pipe internal pressure on the downstream side of the throttle valve and a cylinder intake air flow rate and determined in accordance with at least a setting of said intake air amount changing means and an engine speed.

4. An intake air amount control apparatus as set forth in claim 3, wherein said means for finding the target intake air amount has a means for finding a reference target throttle opening degree, which is a target throttle opening degree in the case where said intake air amount changing means is set to a predetermined reference state, based on said accelerator opening degree and said engine speed, finds said cylinder intake air flow rate for when the throttle valve passage air flow rate found based on said first equation determined by the reference target throttle opening degree found by said means for finding the reference target throttle opening degree and the cylinder intake air flow rate found based on said second equation determined by at least the engine speed assuming that said intake air amount changing means is set to said reference state become equal with respect to the same intake pipe internal pressure at the downstream side of the throttle valve, and makes said cylinder intake air flow rate the target intake air amount or makes a value converted from said cylinder intake air flow rate the target intake air amount.

5. An intake air amount control apparatus as set forth in claim 3, wherein said means for finding the target throttle opening degree has a means for finding a target intake pipe internal pressure, which is the intake pipe internal pressure on the downstream side of the

throttle valve for realizing said target intake air amount when said intake air amount changing means is set to said target setting, based on said target intake air amount and said target setting, and said means for finding the target intake pipe internal pressure finds said target intake pipe internal pressure by entering said target intake air amount expressed by the cylinder intake air flow rate into said second equation determined by at least the engine speed assuming that said intake air amount changing means is set to said target setting.

6. An intake air amount control apparatus as set forth in claim 5, wherein said means for finding the target throttle opening degree further has a means for finding said target throttle opening degree based on said target intake air amount and said target intake pipe internal pressure, and said means uses said target intake air amount expressed by the cylinder intake air flow rate and said target intake pipe internal pressure to find said target throttle opening degree based on said first equation.

7. An intake air amount control apparatus as set forth in claim 1, wherein said intake air amount changing means is an opening characteristic control means for controlling an opening characteristic of at least one of an intake valve and exhaust valve.

8. A method for controlling an intake air amount in an internal combustion engine provided with a throttle valve and an intake air amount changing means linked with said throttle valve,

said intake air amount control method for an internal combustion engine provided with

a step of finding a target intake air amount based on an accelerator opening degree and engine speed,

a step determining a target setting for said intake air amount changing means based on at least said target intake air amount, and

a step of finding a target throttle opening degree, which is a throttle opening degree for realizing said target intake air amount, from said target intake air amount and said target setting based on model equations creating a model of an engine intake system and expressing air passing through said engine intake system.

9. An intake air amount control method as set forth in claim 8, wherein said step of finding the target throttle opening degree has a step of finding a target intake pipe internal pressure, which is an intake pipe internal pressure at a downstream side of the throttle valve for realizing said target intake air amount when said intake air amount changing means is set to said target setting based on said target intake air amount and said target setting, and a step of finding said target throttle opening degree based on said target intake air amount and said target intake pipe internal pressure.

10. An intake air amount control method as set forth in claim 8, wherein the method at least uses, as said model equations,

a first equation expressing a relationship between the intake pipe internal pressure on the downstream side of the throttle valve and a throttle valve passage air flow rate and determined in accordance with a throttle opening degree and

a second equation expressing a relationship between the intake pipe internal pressure on the downstream side of the throttle valve and a cylinder intake air flow rate and determined in accordance with at least a setting of said intake air amount changing means and an engine speed.

11. An intake air amount control method as set forth in claim 10, wherein

said step of finding the target intake air amount has a step of finding a reference target throttle opening degree, which is a target throttle opening degree in the case where said intake air amount changing means

is set to a predetermined reference state, based on said accelerator opening degree and said engine speed,

in said step of finding the target intake air amount, said cylinder intake air flow rate is found for when the throttle valve passage air flow rate found based on said first equation determined by said reference target throttle opening degree and the cylinder intake air flow rate found based on said second equation determined by at least the engine speed assuming that said intake air amount changing means is set to said reference state become equal with respect to the same intake pipe internal pressure at the downstream side of the throttle valve, said cylinder intake air flow rate is made the target intake air amount, or a value converted from said cylinder intake air flow rate is made the target intake air amount.

12. An intake air amount control method as set forth in claim 10, wherein

said step of finding the target throttle opening degree has a step of finding a target intake pipe internal pressure, which is the intake pipe internal pressure on the downstream side of the throttle valve for realizing said target intake air amount when said intake air amount changing means is set to said target setting, based on said target intake air amount and said target setting,

in said step of finding the target intake pipe internal pressure, said target intake pipe internal pressure is found by entering said target intake air amount expressed by the cylinder intake air flow rate into said second equation determined by at least the engine speed assuming that said intake air amount changing means is set to said target setting.

13. An intake air amount control method as set forth in claim 12, wherein

said step of finding the target throttle opening degree further has a step of finding said target

throttle opening degree based on said target intake air amount and said target intake pipe internal pressure,

in said step of finding said target throttle opening degree, said target intake air amount expressed by the cylinder intake air flow rate and said target intake pipe internal pressure are used to find said target throttle opening degree based on said first equation.

14. An intake air amount control method as set forth in claim 8, wherein said intake air amount changing means is an opening characteristic control means for controlling an opening characteristic of at least one of an intake valve and exhaust valve.